Bhattacharya is certainly not an unbiased judge, but a strong partisan of Brahmanism. He denies that the sect-founders are religious reformers in any sense of the word.

> "Looked at with the light of sober common-sense and unbiased judgment, the net result of their so-called reformations is that they let loose on society an army of able-bodied beggars, with the most preposterous claims on the charity and the reverence of the laity. Moral teaching of any kind very seldom forms a part of the programmes of our prophets. They teach their followers to sing some songs which tend either to corrupt their morality, or to make them indifferent to work for the production of wealth" (p. 359).

There is, no doubt, a great deal of truth in this criticism, but it is certainly not the whole truth about the religious systems of India. Our Pandit entirely fails to see the weak points of Brāhmanism which gave rise to the formation of the sectarian religions, and he utterly ignores the influence which the great philosophical systems of India exercised on the development of the sects. And altogether, he is too much of a partisan to be a good historian.

Nevertheless, there is a great deal of valuable information to be found also in this part of Pandit Bhattacharya's book. The numerous Hindu sects are grouped by him under the following classes:—(1) Siva-worshipping sects, (2) Sakti worshippers, (3) Vishnu-worshipping sects, (4) the disreputable Vishnu-worshipping and Guru-worshipping sects, (5) the modern religions intended to bring about union between the Hindus and the Mahomedans, (6) Buddhism, and (7) Jainism.

Not only in the chapter treating of the "disreputable sects," but also in the accounts of the Sivites, Sāktas, and Vishnuvites, much will be found that is of greater interest for the history of morality than for the history of religion. There is hardly one crime, however abominable, that is not recommended by one or the other of the so-called Hindu "religions," and the number of sects sanctioning sexual immorality is so large that we really need the assurance of our author "that the moral nature of the Hindus, as a nation, is, generally speaking, far superior to most of their religions" (p. 458). Although we cannot approve of Pandit Bhattacharya's wholesale condemnation of the Hindu sects, we have to admit that many of the latter-day prophets who founded "sects" during the last centuries fully deserve to be denounced as impostors. Take, for instance, Ram Saran, the founder of the Kartabhaja sect in Bengal:—

> "To be ready with a pretext for exacting money from his followers, he declared that he was the proprietor of every human body, and that he was entitled to claim rent from every human being for allowing his soul to occupy his body. . . . To enforce his right and to give a pecuniary interest to his followers, the Karta appoints the chief men among the latter as his bailiffs and agents for collecting his revenue. The majority of the dupes of the sect are women, who readily pay the small tax that is demanded of them for the sake of securing long life to their husbands and children."

On the whole, I should like to recommend Pandit Bhattacharya's book rather to the scholar than to the general reader. At any rate, the latter will do well never to forget that the author is himself a member of one of the most aristocratic Brāhman castes. But the student of the history of civilisation in India will find in this book a great deal of useful and highly interesting information.

The value of the book is enhanced by an excellent index and glossary. M. WINTERNITZ.

EXPERIMENTAL MORPHOLOGY.

Experimental Morphology. By Charles Benedict Davenport, Ph.D., Instructor in Zoology in Harvard University. Part First. *Effect of Chemical and Physical Agents upon Protoplasm.* Pp. xiv + 280. (London: Macmillan and Co., Ltd., 1897.)

THE term "experimental morphology" is new, and requires to be defined. We cannot do better than quote the author's own definition.

> "Several distinct steps can be recognised in the progress which has been made in the interpretation of form. The earlier studies were concerned chiefly with answering the question, *What* are the differences between the various adult forms? The results of observations and reflections relating to this question constitute the sciences of descriptive and comparative anatomy. Next, a more fundamental inquiry was entered upon: *How* are these forms produced or developed? The results of observations and reflections upon this subject constitute the science of comparative embryology. Finally, in these later days a still more fundamental question has come to the front: *Why* does an organism develop as it does? What is that which directs the path of its differentiation? This is the problem which the new school of 'Entwicklungsmechanik' has set for itself—it is likewise the problem with which this book is concerned.
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> "The causes which determine the course of an organism's development are numerous, but fall into two general categories: namely, internal causes, which include the qualities of the developing protoplasm; and external causes, which include the chemical and physical properties of the environment in which the protoplasm is developing. . . . It is the purpose of the present work to consider the effects resulting from external causes.
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> "When we wish to isolate the separate effects in any complex of causes, we must resort to the well-known procedure of experimentation. . . . Accordingly we call in experiment to get an insight into the causes of organic form, and thus justify the name which we have applied to our study."

The author proposes to attack the problem of the influence of external agents upon organisms from four points, viz.: (1) their influence upon the phenomena exhibited by all living protoplasm; (2) their influence upon growth; (3) their influence upon cell division; and (4) their influence upon differentiation. The present volume deals with the first point only, and its scope will be best understood if we say that it treats of the *physiology of protoplasm.*

The book is mainly based upon the work of others, and owes not a little to Verworn. It is, in fact, the author's expressed aim "so to exhibit our present knowledge in the field of experimental morphology as to indicate the directions for further research." It is therefore

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essentially a work of reference, and is rendered the more valuable in this respect by the addition of a fair bibliography appended to each chapter. The physiological character of the work will be at once recognised when the subjects treated of are enumerated. The action of chemical agents upon protoplasm is first dealt with, including the action of drugs and the relation between molecular composition and physiological action. The question of acclimatisation (immunisation) is considered both for inorganic and organic poisons. The author does not confine himself to the action of external agents upon single cells or unicellular organisms, but includes their action upon the whole organisation of individuals belonging to the higher vertebrates. Thus we find such experiments as those of Calmette upon immunisation to snake venom, and those of Nuttall and Thierfelder upon bacterium-free guinea-pigs, laid under contribution. The influence of oxygen upon the movements of bacteria and unicellular organisms, and the phenomena of chemotaxis in general occupy a special section of the chapter on chemical agents. The interesting observation of Roux, that isolated cells from the blastula of the frog move slowly in fluid, their movements being influenced by the presence of neighbouring cells, is referred to as a special morphologically interesting case of chemotaxis. The effect of adding or removing water to or from protoplasmic organisms: their vitality in circumstances producing desiccation, and the limits of such desiccation in the case of lower organisms, germs and seeds. The osmotic effects of solutions (with a very clear and interesting account of de Vries' fundamental experiments); this section includes also the acclimatisation of organisms to solutions of salt, *e.g.* of fresh-water organisms to seawater, and *vice versâ*. The effects of mechanical disturbance—mechanical stimulation—upon amœboid movements, and upon direction of locomotion, including the effects of fluid currents (rheotaxis). The effect of gravity (geotaxis). That of electricity, and the differences displayed by different organisms in responding to galvanic currents, some, such as most Protozoa and Mollusca, responding to the positive pole (reacting at the anode on closure of the current)—anode-excitable or anex type—others, such as the Arthropoda and Vertebrata, responding to the negative pole (reacting at the kathode on closure of the current)—kathode-excitable or katex type. The phenomena of electrotaxis (positive and negative) in various organisms, the following general law being laid down for Metazoa: "Positively electrotactic organisms exhibit the katex type of irritability; and negatively electrotactic organisms exhibit the anex type, or, in general, the organism turns tail to the exciting pole." The action of light upon protoplasm, especial attention being given to the experiments of Engelmann with the microspectro-photometer, and those of Marshall Ward on the bactericidal action of the luminous rays. The phenomena of phototaxis and photopathy, including the effects of light in producing both bodily movements of organisms and movements of the protoplasm of cells, *e.g.* of pigment cells in the skin and retina. The effect of heat upon protoplasm, including the phenomena of rigor, both temporary and permanent, in muscle, with an interesting section on acclimatisation of organisms to extreme temperatures.

These are the subjects treated of, and it will be seen from the mere enumeration of them that the book covers a vast field of research: too vast to be really adequately dealt with within the modest limits of 280 octavo pages; nevertheless, it offers a valuable aid to the English student of biology. If we compare it with Verworn's well-known "Allgemeine Physiologie" (a better term, in our opinion, than experimental morphology—at least as applied to the subjects treated in this part of the work), which is a larger book covering the same ground, we find far fewer original experiments and observations, but a more complete account of the literature. Nevertheless, there are several noteworthy omissions. In dealing with the effects of chemical agents, the question of antagonism is untouched, and the important work of Ringer and others upon this subject is unnoticed. The same may be said for the work of Brunton, Cash, and others upon the relations between chemical constitution and physiological action. The chemical changes in protoplasm attendant upon its activity, and the effect of external agents upon such changes, are hardly so much as alluded to. The name of Romanes is nowhere mentioned, although his experiments upon the influence of chemical agents, of light, of gravity, and of electricity upon both animal and vegetable organisms are full of interest. But perhaps the most serious omission is the *relative lack* of allusion to the effects of external agents upon plant protoplasm In view of the light which may be thrown upon the phenomena exhibited by animal organisms by an account of those exhibited by plants under similar circumstances, it is in the highest degree desirable to bring the evidence derived from the two kingdoms together. For although, as the author puts it, protoplasm "must be a very dissimilar thing in different organisms," there must, nevertheless, be somewhere a fundamental identity between protoplasm from all sources. And, indeed, the author admits this:

> "It is with living *organisms* that we have to deal, and, accordingly, no distinction should be made between animals and plants. I have, indeed, made no such distinction; nevertheless, tastes and training have led me to lay especial stress upon animals. Even this is unfortunate, for the problem with which we are concerned is precisely the same problem in all *living organisms*."

We must, however, take the book as we find it, and although one could have wished it to be more developed in certain directions, it is still the most complete account in the English language of what may be termed (with Verworn) general physiology. This is a subject the study of which has increased so largely of late years, that there is hardly room for it to be more than merely touched upon in text-books of physiology; it has, in fact, grown into a self-contained branch of that science, with a more or less morphological bearing, and, as with the case of the morphology of the cell, is beginning to require a text-book to itself. We are glad to welcome Dr. Davenport's book as an attempt to furnish us with such a text-book in our own language.

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